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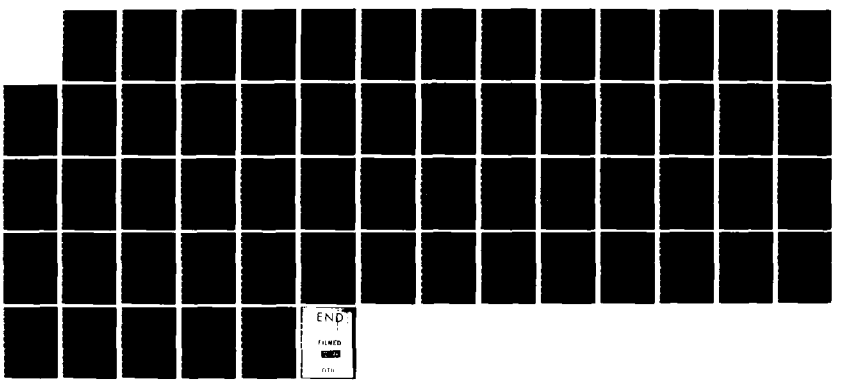

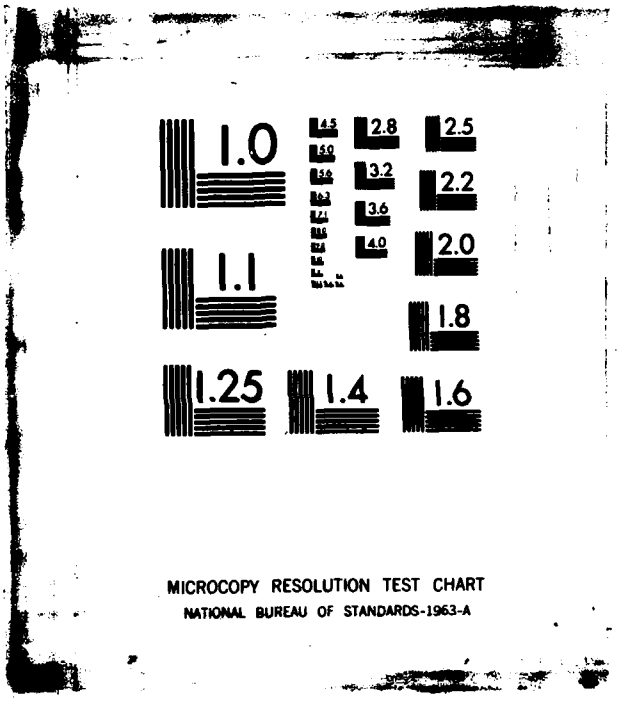
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# THE CONCEPT OF INFORMATION REDUNDANCY IN SOCIAL COGNITION

John B. Pryor, Terry L. Kott, and Greg R. Boveé

University of Notre Dame

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# The Concept of Information Redundancy in Social Cognition

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Running Head: Social Cognition

## Abstract

The following question is addressed: How do multiple, simultaneously present cognitive structures influence the representation and recall of social information? In an empirical study examining both free and cued recall, we found the variable information redundancy to influence both the orgnization and accuracy of subjects' recollections of trait-related behaviors. Redundancy was defined in terms of the degree of person/trait overlap in a social information ensemble. Some evidence indicated that this effect is attributable to an increase in the discriminability of the organizational structures during encoding. The implications of these findings for understanding the formation of integrated cognitive representations of individuals are discussed.

# The concept of information redundancy in social cognition

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University of Notre Dame

Recently, social psychologists have developed an interest in examining the structures people use in processing social information. Many of the conceptual models used in this research have been derived from research in the general cognitive literature. Among the different concepts of knowledge representation employed are: prototypes (Cantor, Mischell & Schwartz, 1982), schemata (Fiske & Linville, 1980; Taylor & Crocker, 1981) and scripts (Abelson, 1981). Hastie (1981) and others (e.g., Wyer, 1980) have suggested that the organizational properties of these various conceptual models are similar enough to subsume them into a single concept. Hastie prefers to call this general concept a schema. Other researchers (e.g., Lingle & Ostrom, 1982; Ostrom, Pryor & Simpson, 1981) have similarly assumed a basic continuity in the general principles of cognitive organization extending across various different content domains of social information.

A problem often overlooked in research on the cognitive organization of social information is that of <u>multiple organization</u>. Social information involves a diversity of referents and may be simultaneously organized according to a variety of different knowledge structures. Consider the following example: While waiting for a bus on Tuesday morning, a man observed his neighbor's son, a boy scout, escort an old lady across the street. This brief social experience has many possible cognitive referents.

Some of these may be termed episodic referents because they involve associations to specific contexts or individuals. These might include: things that happened on Tuesday or things about the neighbor's son. Others may be termed semantic referents because they involve general knowledge of the world. These might include: things boy scouts typically do or examples of kind behaviors. This distinction is analogous to Tulving's (1972) use of these terms.[1] In some senses, all of these referents imply organizational structures to which this experience is associated. Thus, the use of these different referents may have important implications for how the experience may be subsequently retrieved from memory. In this article, we will attempt to address the issue of how these multiple, simultaneously present modes of cognitive organization might influence the representation and recall of social information. We will use the term social information in a manner similar to the way the term was used in Pryor and Ostrom (1981). At least one of the potential episodic referents for each item of social information is a person. Items of social information are encountered in a temporal sequence, involve several different possible organizational referents over a span of time, include a variety of items about each organizational referent and are interspersed between organizational referents in an arbitrary fashion.

Pryor, Simpson, Mitchell, Ostrom and Lydon (in press) report a recent series of studies concerned with multiple organization in social information. These studies contrasted organization by persons to organization by general descriptor categories and temporal-context categories. In these studies, subjects read social

information ensembles containing two orthogonal organizational structures arranged in a matrical fashion. Cognitive organization according to one structure or the other was inferred by examining clustering patterns in subsequent free recall. These researchers found that subjects tended to organize free recall according to person-based structures when the stimulus persons were familiar; whereas, subjects were more likely to organize according to either descriptor or context based structures when the stimulus persons were unfamiliar.

These studies presented subjects with an either/or situation: organizing the recall of social information by persons inhibited organizing the information according to descriptor categories (or temporal context categories) and vice versa. This competition existed because of the orthogonal arrangement of organizational structures in the information ensembles. Studies employing information ensembles of this sort are valuable for answering questions of organizational strength. Which of two competing organizational alternatives is stronger?

In considering the interfaces of the alternative organizational structures encountered in everyday social experience, it seems that a variety of possible relationships among alternative organizational structures can exist. These relationships might range from completely orthogonal structures, as in the Pryor et al. (in press) studies, to completely redundant structures where organization according to one structure implies, de facto, organization according to another.

The concept of information redundancy first emerged in Shannon

and Weaver's (1949) early mathematical theory of communication. More recently, Garner (1962, 1969, 1975) has extensively employed this concept in analyses of the discriminability of abstract figures. In experiments involving random dot patterns Garner (1969) has shown attribute redundancy to be an important factor in subjective judgments of "goodness of pattern" and pattern discriminability. Figures with high redundancy are judged to be "good gestalts." A highly redundant pattern would appear to be more discriminable during the encoding of information.

These concepts may be operationalized using social information ensembles. Figure 1 shows an orthogonal relationship between two organizational dimensions (Panel A) contrasted to a redundant relationship (Panel B). The two organizational dimensions, persons and traits, represent episodic referents and semantic referents, respectively. The information patterns depicted in Panel B would presumably be more likely to be judged "good gestalts". Analogous to Garner's analyses, we might infer that the configurations of social information in Panel B might represent more discriminable organizing categories which subjects might find easier to use. In contrast, the relationships depicted in Panel A present a social perceiver with conflicting patterns of organization. The expectations of which behaviors should go together based upon the semantic referents are different from the observed pattern of associations to episodic referents. One consequence of encountering information with such orthogonal organizing dimensions may be subsequent confusion in the recall of the specific associations. In the examples of Figure 1, this translates into confusing which

behavior went with which person.

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Insert Figure 1 about here

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Thus, the question of how multiple organization influences the representation and recall of social information may hinge upon the particular relationship between the salient organizational dimensions: Are the organizational dimensions redundant and complimentary or are they orthogonal and conflicting? Redundant relationships between organizational dimensions may enhance cognitive organization and subsequent recall; whereas, orthogonal relationships may impede cognitive organization and recall.

In the present investigation we were not content to look at only these extreme conditions. We examined a range of relationships, varying systematically between orthogonal and redundant patterns. The salient organizational dimensions in our information ensembles were persons (a set of episodic referents) and trait-categories (a set of implicit semantic referents). We chose these two organizational dimensions for three basic reasons: (1) Episodic and semantic referents are inherent in virtually any social experience. Thus, the wealth of any person's social experience has likely included many possible relationships between episodic and semantic referents. (2) Research by Cantor & Mischel (1977, 1979) has indicated that trait concepts can play an important role in the memory for information about persons. This seems to be true even when the traits are implicit, that is, they are abstractions derived by the subjects. However, previous research on the organizational

functions of trait concepts has examined experimental situations where subjects focus upon only one person at a time. Pryor and Ostrom (1981) have pointed to some of the limitations in this methodology. Natural social experiences are not necessarily organized according to individuals. Social cognition methodologies which force a subject to focus upon one stimulus person at a time may encourage subjects to consider the stimulus persons as organized units to a greater extent than they would normally. Thus, the organizational function of trait concepts in a stream of arbitrarily organized social information remains an empirical question. One assumption that we make about trait concepts is that they normally function as ways of organizing information about particular individuals (not necessarily encountered in isolation of the people). That is, traits normally function at an intra-person level of organization and not an inter-person level. Phenomenologically, traits serve as ways of explaining intra-person consistencies in behavior. Thus, we might expect traits to play a more important role in cognitive organization when they are more redundant with person categories. (3) One of the enduring goals of our research program (Pryor & Ostrom, 1981; Pryor & Ostrom, 1982; Pryor, Ostrom, Dukerich, Mitchell & Herstein, in press) is to examine the circumstances under which persons emerge as organizing categories. Asch (1952) assumed that the information about a person automatically forms a <u>person gestalt</u> in the mind of the social perceiver. He based this idea on the basic perceptual research of his time. In the present investigation we varied an information quality (redundancy) shown in more contemporary research on basic

perception to influence subjects' judgments of what represents a "good gestalt" (Garner, 1970). Thus, we are attempting to specify some of the conditions under which subjects will form integrated person units (person gestalts) from a stream of social information.

Our basic experimental procedure was really quite simple. We asked subjects to read an ensemble of social information involving several persons performing trait-related behaviors. After a brief distractor, they were asked to freely recall the information. This sequence was repeated four times. Finally, subjects were given a set of cues (either the names of stimulus persons or the trait category labels) and once again asked to recall the information. We systematically varied the degree of information redundancy or person/trait overlap in the social information ensembles across five levels. We predicted that the use of either persons or traits as organizing categories in free recall (as indicated by clustering patterns) would increase as a function of the information redundancy (person/trait overlap). Also, we predicted that accuracy in free recall would be influenced by the redundancy manipulation. Lower levels of redundancy (where the structural relationships approach orthogonality) should be associated with more inter-episodic (or inter-person) confusion errors.

The inclusion of the cued recall helped us to explore two aspects of subjects' information processing not readily apparent from the free recall alone. First, we were able to gain some evidence as to whether the redundancy manipulation influenced encoding processes. Tulving and his associates (Tulving & Osler, 1968; Tulving & Thompson, 1973) suggest that cues which are present

during encoding are more likely to serve as effective retrieval cues. If the function of redundancy is to increase the discriminability of either organizational structure during encoding then the manipulation of redundancy should influence the relative effectiveness of either persons or traits as retrieval cues. Second, we were able to explore some of the alternative explanations of why subjects might manifest low levels of free recall organization in the low redundancy conditions. Our prediction in the free recall was that person and trait clustering would be low when redundancy was low. This could result from subjects' alternating between different organizational structures during recall. Such behavior would imply that subjects employed a complex matrical representation of the social information ensembles involving both organizational structures. If subjects evolved such complex representations then either type of cue (persons or traits) might prove equally effective during retrieval irrespective of the degree of person/trait redundancy. On the other hand, if the persons and traits are more discriminable as organizing categories as a function of redundancy level, then persons or traits should serve as more effective retrieval cues as redundancy increases.

## Method

### Stimulus Construction

Two stimulus sets were developed as separate replications. We began by selecting 25 positive and 6 negative traits from Anderson's (1968) list. (The negative traits were included simply to give subjects some contrasts). We asked 17 University of Notre Dame undergraduates to list at least 3 behaviors they considered most

closely associated with each trait. These free associations were collated and we selected 12 positive traits which showed the highest consensus in the behaviors listed. For each trait the three most frequently mentioned behaviors were selected. Similar behaviors were combined by converting them into more general phrases. For example, "listens to Bach" and "listens to Beethoven" were represented by "listens to classical music." These 12 trait/behavior triads were divided into two equal groups, forming the two replications. We attempted to maximize the hetereogeneity of the traits within each group.

The 18 behaviors representing the 6 traits in each replication were systematically combined with the names of 6 hypothetical persons to form 5 different person/trait overlap conditions. In each condition, each name appeared with three different behaviors. These five overlap conditions ranged from no person/trait overlap to complete person/trait overlap. The no overlap stimulus set for one replication is schematically represented in Figure 2.

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Insert Figure 2 about here

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In the no overlap condition, each person was associated with a behavior from each of three different trait categories. In the second degree of overlap, three of the stimulus persons "partially" overlapped with three traits. Each of these three stimulus persons was described with two behaviors from one trait category and one behavior from a different category. In the third degree of overlap all six stimulus persons partially overlapped with traits. In the

fourth degree of overlap, half of the stimulus persons partially overlapped with traits and the other half completely overlapped. Each of these later individuals were described with three behaviors coming from one trait category. In the fifth degree of overlap (complete overlap), each stimulus person was completely redundant with a trait category. These varying degrees of overlap are schematically depicted in Figure 3.

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Insert Figure 3 about here

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**Overview**

The basic experimental design was a 5 (Overlap Conditions) X 2 (Replications) X 2 (Person/trait cues) factorial. Sixty University of Notre Dame undergraduates received extra credit in an introductory psychology course for participation. The subjects were run individually and randomly assigned to the twenty between subject conditions.

**Procedure**

Upon entering the laboratory subjects were informed that the experiment concerned memory for information about persons. Each subject was given an information ensemble from one of the five overlap conditions. Each sentence of this ensemble was printed on a 3 x 5 index card. The subjects were instructed to read each sentence one time aloud at a normal pace. This was followed by a distractor task consisting of 30 seconds of arithmetic calculations. Next, the subjects were given a lined sheet of paper and asked to write down as many sentences as they could remember in the order the

sentences came to mind. This basic EXPOSURE/DISTRACTOR/FREE RECALL sequence was repeated four times. Prior to each exposure the deck of index cards bearing the sentences was shuffled. Following the fourth and final free recall trial, subjects were given a cued recall task. Subjects were presented a small booklet. In the person cues conditions, the name of a stimulus person was at the top of each page. In the trait cues conditions, a trait label was at the top of each page. (Note that the subjects had not been exposed to these trait labels prior to this point). Subjects were told to list the sentences that pertained to each cue as quickly and accurately as possible. A customized Standard timer (Model S-1) was used to time subjects' recall. Subjects were asked to stop the timer upon completion of the booklet.

Measurement of Clustering

The free recall protocols were analyzed for categorical clustering using both the persons and traits as categorical dimensions. Thus, two Adjusted Ratio of Clustering (ARC) indices (Roencker, Thompson & Brown, 1971), a Person and a Trait ARC, were computed from each protocol. These calculations were performed using the Free Recall Organizational Measurement (FROM) system developed by Bovee and Pryor (Note 1). ARC was chosen as an index of organization because it has several advantages over other possible measures (see Murphy, 1979, or Ostrom, Pryor & Simpson, 1981). The free recall protocols were scored for clustering twice, once with a stringent criteria and the second time with a lenient criteria. For the stingent criteria, a response was coded as correct and entered into the clustering computations only if both

the name and behavior were recalled correctly. Errors were ignored. For the lenient criteria, a response was coded as correct if the behavior was recalled correctly, irrespective of whether the name was correct or even present. In both of these scoring criteria a gist standard was employed for the behaviors. We subjected ARC indices from both of the scoring criteria to the analyses reported below. The significant effects detected and the directions of the mean differences were essentially the same for both sets of analyses. Therefore, only the stringent analyses are reported.

## Results

### Clustering

A separate Overlap X Replication X Cue X Trials mixed design analysis of variance was performed on the Person and Trait ARC scores. Our prediction that higher levels of Person/Trait redundancy would result in increased free recall organization on both dimensions was strongly supported. The mean levels of Person and Trait Clustering across the five degrees of overlap are shown in Figure 4.

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Insert Figure 4 about here

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The Overlap main effect was statistically significant for both analyses (Person $F$ (4,50) = 6.65, $p < .01$ and Trait $F$ (4,50) = 15.24, $p < .001$). Both ARC indices showed increases as a function of Trials as well (Person $F$ (3,150) = 3.85, $p < .02$ and Trait $F$ (3,150) = 2.59 $p < .06$).

### Response Types

Further analyses of the free recall protocols were undertaken using a free recall response taxonomy developed by Pryor & Ostrom (1981). This taxonomy categorizes subjects' responses into five mutually exclusive types based upon a separate examination of the name, behavior and name-behavior association in each sentence. While we analyzed each response type separately, only the analyses of two are of direct theoretical interest: the Correct Name/Correct Behavior (CC) and the Mismatch (MM) response types.

The CC response types represent the number of correct person/behavior associations. In an Overlap X Replication X Cue X Trials mixed design analysis of variance, of the CC responses we found a main effect for Overlap ($F$ (4,50) = 3.93 $p < .01$), a main effect for Trials ($F$ (3,150) = 86.97, $p < .01$) and an Overlap X Trials interaction ($F$ (12,150) = 1.94, $p < .04$). The means for the Overlap X Trials interaction are shown in Figure 5. Supporting our hypotheses, the number of correct person/behavior associations increased as a function of overlap. CC responses also increased over successive trials and higher overlap conditions showed more gain over trials. This analysis also detected a Replication X Overlap interaction ($F$ (4,30) = 4.21, $p < .01$) indicating that the overlap effect was somewhat stronger in one replication as compared to the other replication.

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Insert Figure 5 about here

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The MM response types represent confusions of the specific person/behavior (episodic) associations. In this analysis we found

a Trials main effect ($F$ (3,150) = 3.92, $p$ < .02) and a Trials X Overlap interaction ($F$ (12,150) = 2.55, $p$ < .01). The means from the interaction are shown in Figure 6. Clearly, the main effect must be interpreted in light of the interaction. The interaction shows that the MM errors are all roughly equal across the overlap conditions through trials 1 and 2. However, by trial 3 the means spread into two distinct clusters. As indicated by post-hoc contrasts ($p$'s < .05), more MM errors occur in overlap conditions 1 and 2 than in 3, 4, and 5. By trial 4, post-hoc contrasts indicate the following pattern of significant differences (1 and 2) > (3 and 4) > 5 ($p$'s < .05). Thus, by trial 4, we see the predicted pattern of more inter-episodic or inter-person confusions in the lower levels of overlap.

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Insert Figure 6 about here

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**Cued Recall**

Cued recall was scored using a response taxonomy similar to that used in free recall. Here again we will focus upon the CC and MM analyses. An Overlap X Replication X Cue ANOVA for the CC responses revealed a main effect for Overlap. As predicted, the effectiveness of either person or trait cues in producing correct recall increased as a function of person/trait overlap ($F$ (4,40) = 4.93, $p$ < .01). This relationship is shown in Figure 7. A Cue X Overlap interaction was also indicated ($F$ (4,40) = 2.87 $p$ < .04). While the general effectiveness of person and trait cues both increased as a function of overlap, the rate of change was

different. For person cues, the number recalled correctly in the no overlap condition was lower than that of all other overlap conditions, while for trait cues, the number recalled correctly in the first three overlap conditions was lower than the last two (contrast $p$'s < .05). A Replication main effect and a Replication X Overlap interaction were also detected, but these do not seem to qualify the major findings.

An Overlap X Replication X Cue ANOVA for the MM responses showed only a main effect for Overlap ($F$ (4,40) = 3.53, $p$ < .05). This main effect resulted from the No overlap condition producing more mismatch errors than any of the other four conditions. Thus, in the no redundancy condition, subjects were more likely to confuse the specific person/behavior associations.

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Insert Figure 7 about here

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Two additional types of responses were also evidenced in the cued recall: Trait Misperception and Trait Substitutions. Trait Misperceptions occurred when subjects were given a trait cue and wrote down a behavior associated with some different trait category. This response type ocurred only twice in our data indicating that subjects perceived our trait categories as distinct. We also noticed some instances of what we coded as Trait Substitution in the cued recall. For example, when subjects were given an "honest" cue they might write down "Jim Davis was honest" (instead of "Jim Davis does not lie"). While these sorts of responses seem to indicate that subjects recognized the trait relations in the behavior, no

significant effects emerged in the analyses of these responses.

We also analyzed the time subjects took to complete the cued recall task. No significant effects emerged. This may be attributable to the high error variance associated with a single time score analyzed in a between subjects design.

## Discussion

The hypothesis that the redundancy of the organizational structures inherent in an information ensemble would influence cognitive organization seemed to be strongly supported. High levels of information redundancy were associated with more categorial organization according to either person or trait structures and more accurate recall. Low levels of information redundancy were associated with less organization and more confusion errors. The results of our cued recall task indicate that, at least, part of the influence of redundancy may be attributable to enhancing the discriminability of organizational structures during encoding. This analysis is consistent with some of Garner's (1970) findings. We should be cautious, however, in leaping to a conclusion that what we have observed is entirely an "encoding effect." Factors other than the "encoding specificity principle" may influence the effectiveness of retrieval cues (Postman, 1972).

Our results imply a simple, but important point with regard to the relationship between organization and memory. Many times researchers studying social memory functions assume that a more elaborate network of associations among items of information to be remembered will result in more accurate recall. Numerous studies have found support for this assumption (e.g. Hamilton, 1981; Srull,

1981). This sort of analysis is at the heart of "depth of processing" notions (Craik & Lockhart, 1972; Rogers, Kuiper, & Kirker, 1977). Our results imply that the correlational structure inherent in a network of potential associations may be an important factor in mediating its influence on recall. Under some circumstances a more elaborate network of associations might actually impede accurate recall. This would seem to be possible if the associative network incorporated little redundancy in its organizational dimensions.

Our work appears to compliment the work of Canter and Mischel (1977, 1979) on traits as prototypes for organizing social information. Our stimulus persons were more likely to emerge as organizing categories when they were redundant with trait concepts. When person referents were less correlated with trait referents, the organizational impact of both was diminished. In a similar vein Cantor and Mischel (1979) find that when an individual fits well in a particular trait category memory for the details of his/her behaviors improves. We feel that our findings help to extend the understanding of how trait concepts function in the context of arbitrarily organized social information.

More broadly, traits and other organizational structures necessarily function in the context of a variety of possible organizational alternatives, some semantic and some episodic. Social experience confronts us with many different correlational relationships among these organizational structures. Some examples of common social experiences that represent analogues to conditions in our experiment are found in the information contained in job

applications and second hand impressions. A personnel manager who reviews job applications is often faced with a situation somewhat analogous to our no overlap condition. The information categories on job application forms (e.g. age, educational background, past employment experience, etc.) cross-cut the person categories. Also, information may be missing for some categories. This situation makes it difficult to form "person gestalts" of the individual applicants. In contrast, second hand impressions, where we learn about someone from a third party, are often conveniently organized according to consistent trait categories or types (Harvey, Harkins & Kagehiro, 1976; Leventhal, 1962). In this case, it is easy to form a "person gestalt" of the individual. This, of course, parallels in some ways the kind of information in our high redundancy conditions. We conjecture that most social experience falls somewhere between these two extremes.

Redundancy is one factor that can make an organizational structure salient or discriminable to the social observer. Other factors include the processing goals of the observer (Hamilton, 1981; Hoffman, Mischel & Mazze, 1981) and the accessibility of the structure (Higgins & King, 1981). In future investigations it would be interesting to explore the interaction of these factors in determining the cognitive organization of social information.

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## Footnotes

The concept, episodic knowledge, is used somewhat differently here as compared to Tulving's use of the term. We are suggesting that episodic information may be organized according to specific categorical structures with no obvious semantic cohesiveness. This seems similar to Anderson's (1977) analysis of how individuals are represented in memory.

## Figure Captions

Figure 1. A completely orthogonal relationship between persons and traits (Panel A) and a completely redundant relationship (Panel B).

Figure 2. A no-overlap replication.

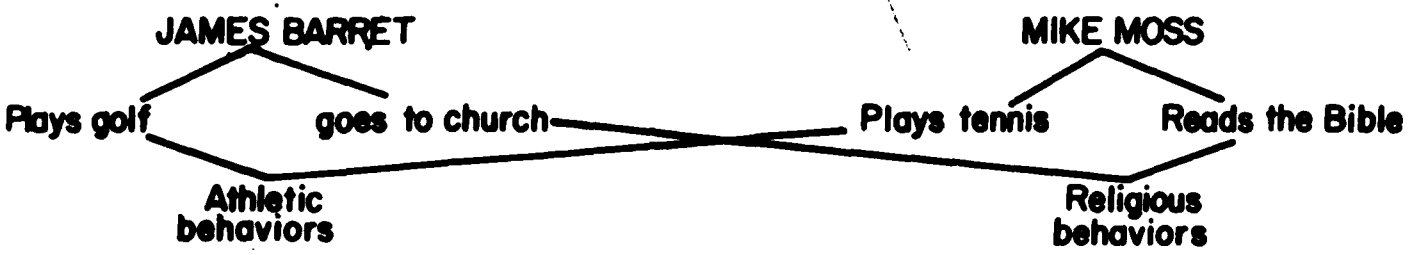
Figure 3. The variation of person/trait overlap.

Figure 4. Person and trait clustering (ARC) as a function of overlap conditions (1-5).

Figure 5. The number of correct person/behavior associations (CC) in free recall as a function of overlap conditions (one through five) and trials (1-4).

Figure 6. The number of person/behavior confusions (MM) in free recall as a function of overlap conditions (one through five) and trials (1-4).

Figure 7. The number of correct person/behavior associations (CC) in cued recall as a function of overlap conditions (1-5).

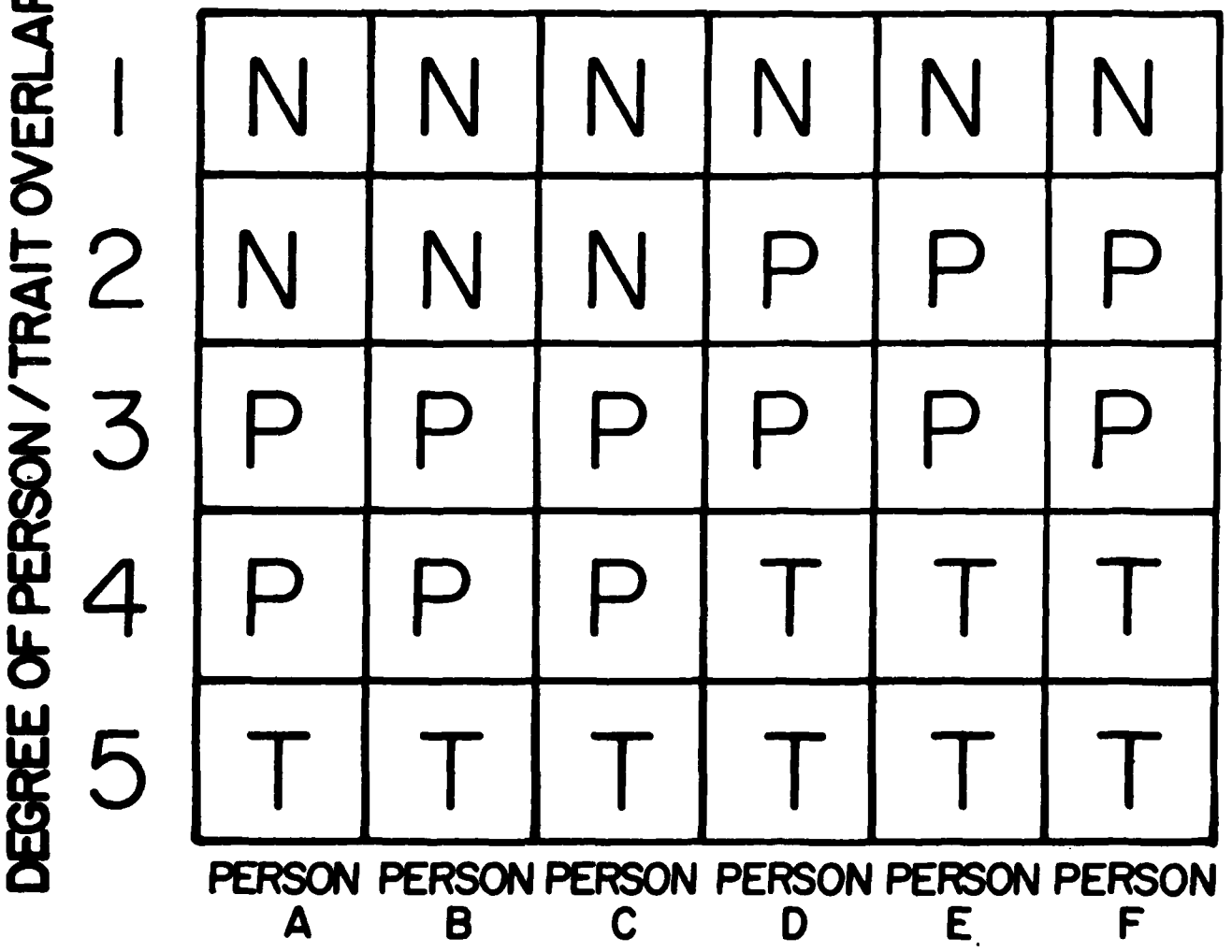



Panel A Orthogonal Relationship of Persons to Traits

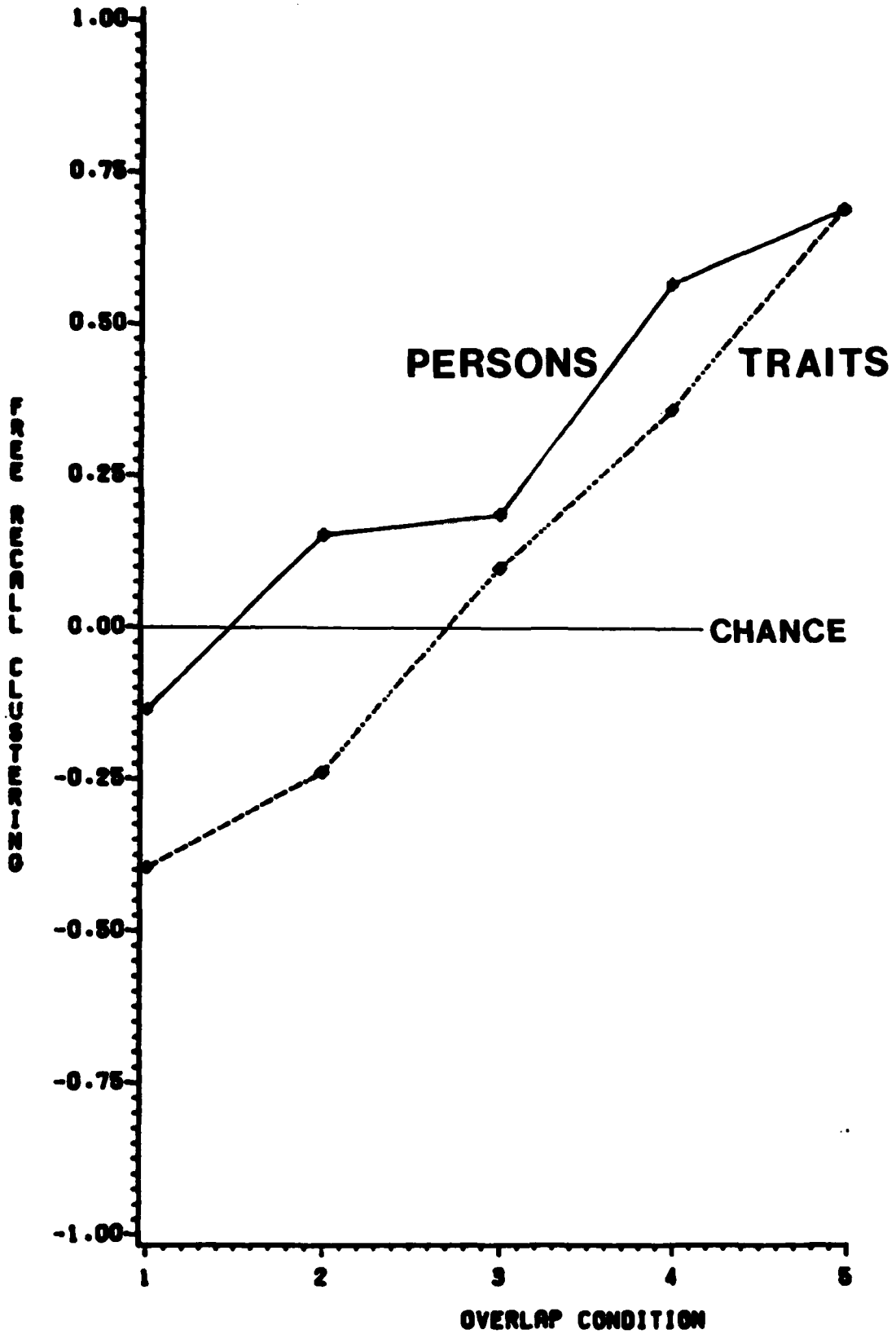

Panel B Redundant Relationship of Persons to Traits

# PERSONS

| TRAITS | JIM DAVIS | KEITH LARSON | JOHN SANDERS | LARRY MILLS | RICH WALTERS | STEVE ROSS |
|---|---|---|---|---|---|---|
| HONEST | DOES NOT LIE | NEVER CHEATS | RETURNS LOST ITEMS | | | |
| SOCIABLE | | ENJOYS MEETING NEW PEOPLE | ATTENDS MANY PARTIES | IS A GOOD CONVERSA-TIONALIST | | |
| ARTISTIC | | | LIKES TO DRAW & PAINT | IS VERY CREATIVE | APPRECIATES ART | |
| RELIGIOUS | | | | ATTENDS CHURCH REGULARLY | READS THE BIBLE | PRAYS OFTEN |
| PATIENT | IS GOOD WITH CHILDREN | | | | DOES NOT GET MAD EASILY | WAITS CALMLY |
| PUNCTUAL | LOOKS AT HIS WATCH | WORRIES OVER DEADLINES | | | | ARRIVES ON TIME |




N=NO OVERLAP P= PARTIAL OVERLAP T= TOTAL OVERLAP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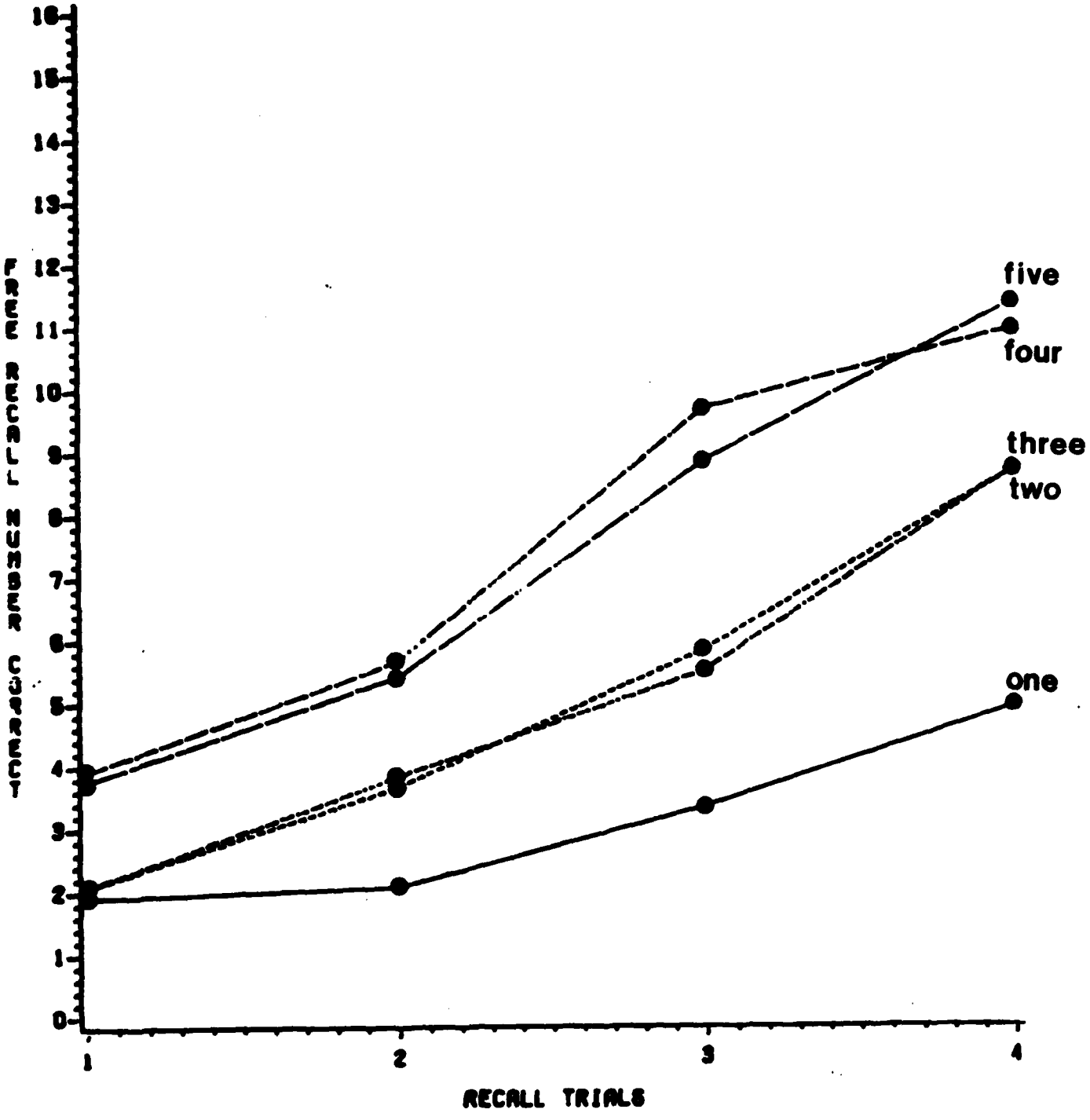
CLUSTERING FREE RECALL
PERSONS
TRAITS
CHANCE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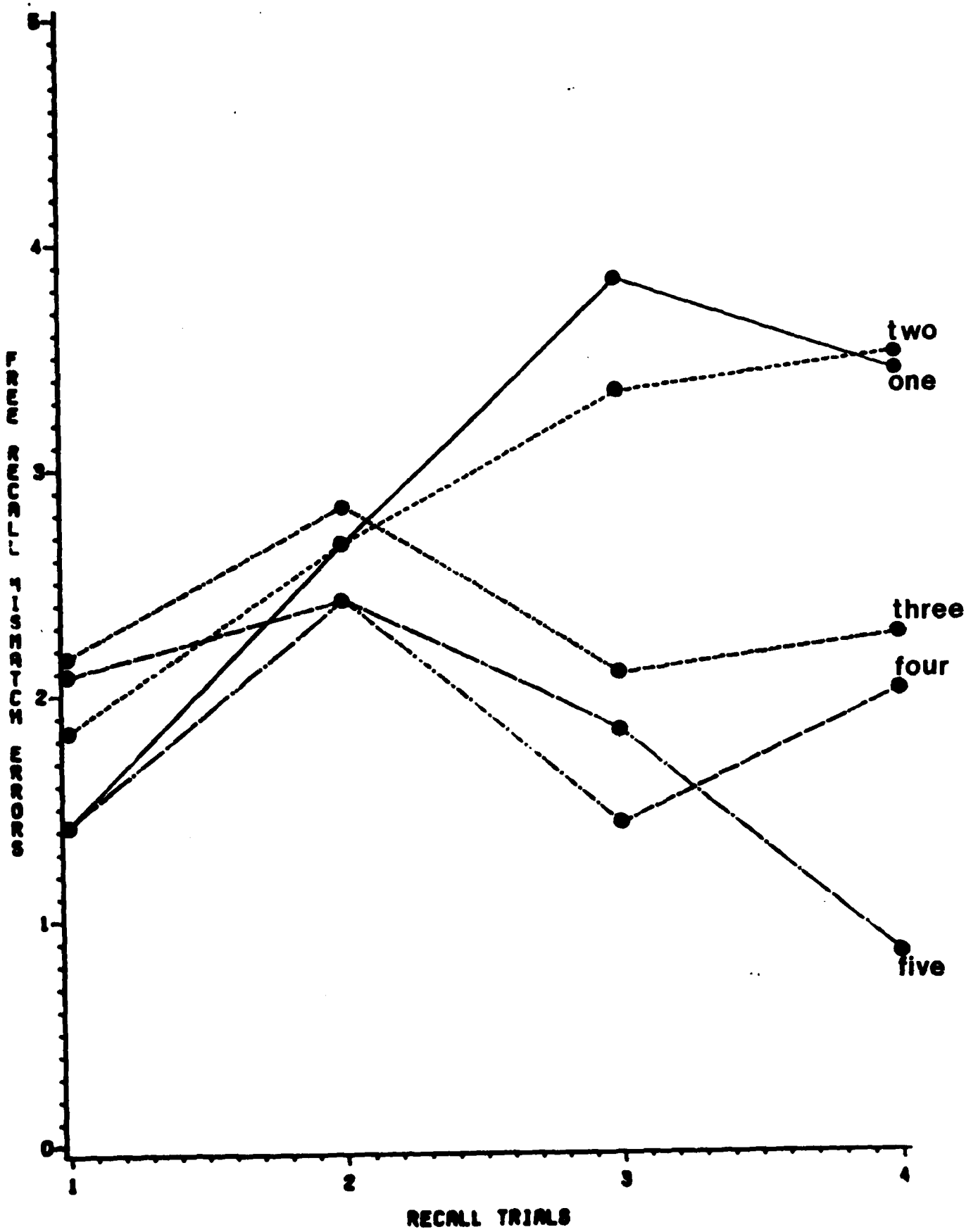
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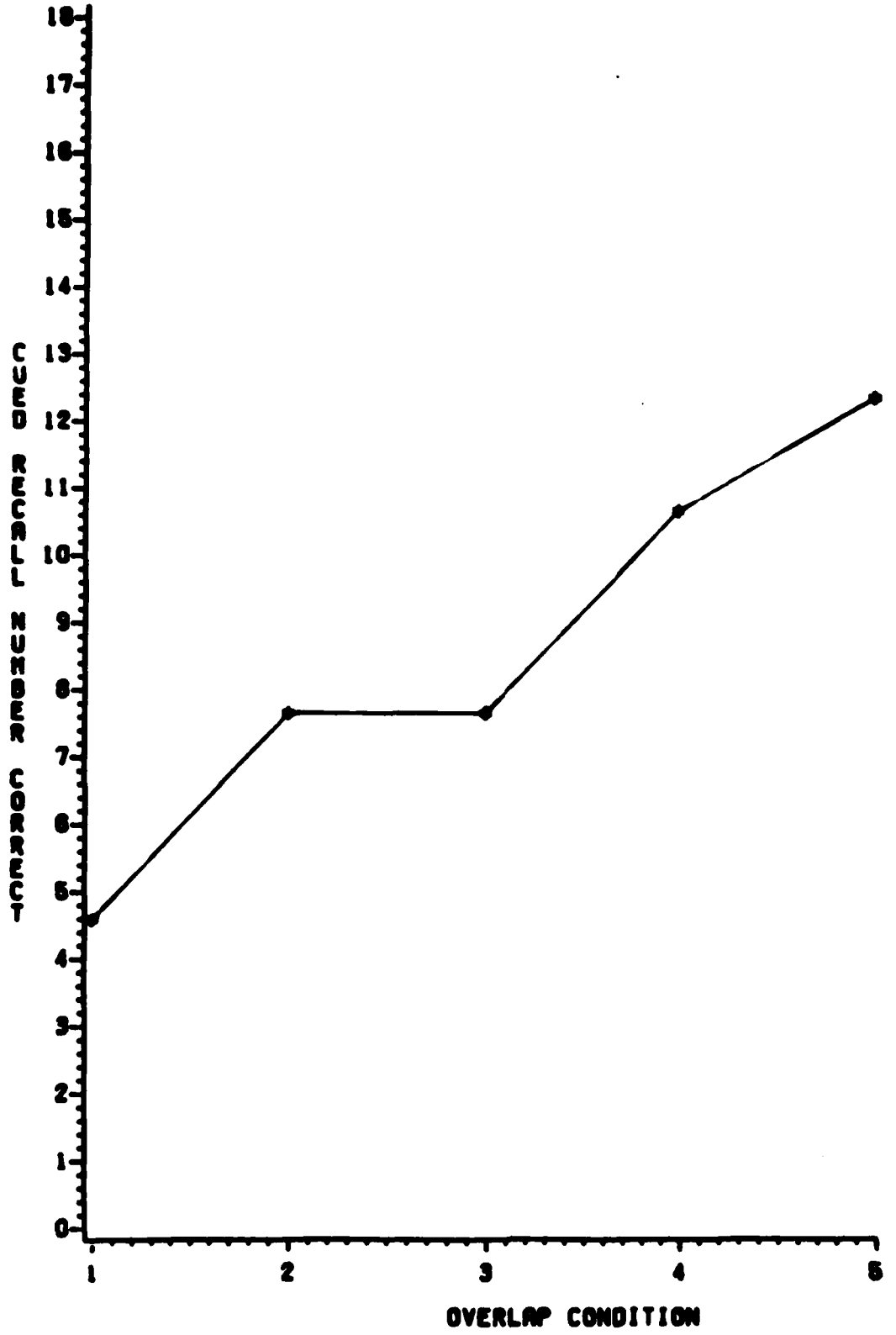
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